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Trends associated with distal biceps tendon repair in the United States, 2007 to 2011

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Background: Current studies investigating surgical treatment of distal biceps tendon tears largely consist of small, retrospective case series. The purpose of this study was to investigate the current patient demographics, surgical trends, and postoperative complication rates associated with operative treatment of distal biceps tendon tears using a large database of privately insured, non-Medicare patients.

Methods: Patients who underwent surgical intervention for distal biceps tendon tears from 2007 to 2011 were identified using the PearlDiver database. Demographic and surgical data as well as postoperative complications were reviewed. Statistical analysis was performed using linear regression analysis and χ^2 tests, with statistical significance set at $P < .05$.

Results: A total of 1443 patients underwent surgical treatment for distal biceps tendon tears. Men and patients aged 40 to 59 years accounted for 98% and 72% of the cohort, respectively. Regarding surgical technique, reinsertion to the radial tuberosity was preferred (95%) over tenodesis to the brachialis (5%) ($P < .01$). In total, revision surgery for tendon rerupture occurred in 5.4% of treated patients. The incidence of revision surgery for rerupture in acute and chronic distal biceps tears was 5.1% and 7.0%, respectively ($P = .36$). Postoperative infection and peripheral nerve injury rates were 1.1% and 0.6%, respectively.

Conclusion: Surgeons strongly preferred anatomic reinsertion to the radial tuberosity for treatment, regardless of the chronicity of the injury. Postoperative complication rates were similar to those found in prior studies, although the true rate of rerupture may be higher than previously thought.

Level of evidence: Level IV; Case Series Using Large Database; Treatment Study

Keywords: Distal biceps; tendon; elbow; repair; complications; rerupture

Distal biceps tendon tears account for 10% of all biceps brachii injuries and, when left untreated, can result in significant weakness and early fatigue with activities that require elbow supination and flexion.[28] These injuries occur during sudden eccentric loading of the biceps and are most commonly observed in middle-aged men.[13,17,27] Early diagnosis

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Table I *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) and *Current Procedural Terminology* (CPT) codes used to identify patients surgically treated for distal biceps tendon tears and associated postoperative complications

Diagnosis or procedure	ICD-9-CM or CPT code
Acute distal biceps tendon rupture	ICD-9 841.8
Chronic distal biceps tendon rupture	ICD-9 727.69
Reinsertion of ruptured biceps tendon, distal, with and without tendon graft	CPT 24342
Tenodesis of biceps tendon at elbow	CPT 24340
Postoperative infection/hematoma (débridement procedure)	CPT 10060, 10061, 10140, 10160, 10180, 11000, 11040, 11041, 11042, 11043, 23930, 23920, 23935, 25028, 25028, 25035
Peripheral nerve injury	ICD-9 955.1, 955.2, 955.3, 955.4, 955.5, 955.7, 955.8, 955.9
Compartment syndrome (fasciotomy)	CPT 24495, 25023, 25020, 25024, 25025
Rerupture (reinsertion/tenodesis)	CPT 24342, 24340
Postoperative heterotopic ossification	ICD-9 728.13
Radioulnar synostosis	ICD-9 755.53
Elbow arthrofibrosis (elbow manipulation)	CPT 24300

and anatomic repair of the avulsed tendon to the radial tuberosity are recommended to restore both supination and flexion strength,[7] although tenodesis to the brachialis has been described as a successful alternative treatment option in select cases.[26] Ultimately, surgical decision-making is based on an array of factors, including the age and lifestyle of the patient as well as chronicity of the injury.[26]

During the last 2 decades, various surgical approaches and tendon fixation techniques have been developed to improve fixation strength, to limit complications, and to allow early functional recovery. However, because of the relative rarity of these injuries, current studies examining surgical treatment and outcomes mostly consist of small retrospective case series.[2,3,5,7] As such, reported complication rates vary widely. The incidence of nerve injury ranges from 5% to 13%,[8,10] whereas the rate for heterotopic ossification ranges from 0% to 65%.[4,25,27] In addition, the incidence of reruptures has been reported from 2% to 8%,[5,17,20,24] although most studies report zero reruptures in their series.[14,16,22,23,25] Furthermore, although repair of chronic ruptures is thought to be more susceptible to rerupture because of difficulties with fixation and the need for an interposition allograft, most case series report zero reruptures in their cohort.[11,12,18,19,31] This has led some authors to suggest under-reporting of this complication.[8]

The purpose of this study was to investigate the current patient demographics, surgical trends, and postoperative complications associated with surgical treatment of distal biceps tendon ruptures using a large national private payer insurance database.

Materials and methods

Patients undergoing surgical treatment for distal biceps tendon tears were identified within the PearlDiver Patient Record Database (PearlDiver Technologies, Warsaw, IN, USA; www.pearldiverinc.com) using a combination of *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) and *Current Procedural Terminology* (CPT) codes (Table I). To our knowledge, this database is the largest private payer database in the United States, with UnitedHealth Group having the largest number of patient records. From 2007 to 2011, the database captured 24.6 to 26.3 million patients, representing approximately 9% of the U.S. population younger than 65 years and approximately 13% of the U.S. population with private insurance, according to data from the U.S. Census Bureau.

To ensure appropriate study inclusion, we used a predetermined algorithm to identify patients treated for distal biceps tendon tears during the study period. Patients were identified using the ICD-9 diagnosis codes for acute (841.8) and chronic distal biceps tendon injury (727.69) in conjunction with the CPT codes for reinsertion with or without graft (24342) or tenodesis to the brachialis (24340) using Boolean search language. Demographic data, which consisted of the patient's gender and age and the year and region in which the patient was treated, were collected.

From this cohort, commonly recognized postoperative complication rates were collected using predetermined ICD-9 and CPT codes (Table I). Postoperative rates for infection/hematoma, peripheral nerve palsy, and compartment syndrome were elicited within 30 days of the index surgery. Patients were recognized as incurring a postoperative infection/hematoma or compartment syndrome if they underwent a surgical débridement or fasciotomy procedure, respectively, in this early postoperative period (within 30 days). Postoperative rates for tendon reinjury, elbow arthrofibrosis, heterotopic ossification, and radioulnar synostosis were elicited within 1 year of the index surgery. Patients were recognized as incurring a recurrent injury or elbow arthrofibrosis if they underwent a revision repair or elbow manipulation procedure, respectively, during the postoperative period (within 1 year).

Statistical analysis

Linear regression was used to examine differences in trends over time. The χ^2 test was used to examine the association